OUR ASTRONOMICAL COLUMN.

An Asteroid-Orbit of Great Eccentricity.—Prof. E. C. Pickering announces that from an examination of a plate taken on August 14, 1901, with the Bruce telescope, Dr. Stewart found an asteroid having the great southern declination, – 62°. Fourteen photographs were taken up to November 13, furnishing approximate positions for the computation of the orbit. A circular orbit was first calculated, which gave the surprising result that the heliocentric diurnal motion exceeded 2200″, indicating a distance from the sun less than that of any known asteroid. Prof. Newcomb furnishes the following elements :—

Epoch 1901, October 2·627 G.M.T.

$$\begin{array}{ll} M = 358^\circ\ 30' & \phi = 22^\circ\ 8' \\ \left.\begin{array}{l} \omega = 301\ 19 \\ \Omega = 35\ 48 \\ i = 18\ 38 \end{array}\right\} 1900.0 & \begin{array}{l} \mu = 860'' \\ \log a = 0{\cdot}4103 \\ \text{Period} = 4{\cdot}13 \text{ years.} \end{array} \end{array}$$

The uncertainty of the elements ω and ☊ may be about ±1°. It would thus appear that the ellipticity of this new planet is in considerable excess over that of any previously known asteroid. The only others for which φ exceeds 20° are :—

	°	′
Eva (164)	20	19
Istria (183)	20	27

The new asteroid was near perihelion at the time of its discovery, moving rapidly round the sun at a distance of about 1·6. It is rapidly moving north, and will soon be available for observation from northern observatories, as shown by the following approximate ephemeris for Greenwich midnight :—

1901.	R.A. h. m.	Decl. ° ′
Dec. 21·5	23 11·3	– 11 42
Jan. 10·5	23 51·8	– 3 47
,, 30·5	0 31·9	+ 3 26

Bright Meteor of December 16.—An exceedingly brilliant meteor was observed at South Kensington on the evening of Monday, December 16, about 6·45 p.m. Starting from near α Persei, about 60° elevation, it travelled in a northerly direction inclining downwards until, after a path of about 30°, it disappeared beneath the Pole star. The meteor was two or three times brighter than Capella, and appeared of a similar tawny yellow colour, although this might have been mainly due to the slight fog prevailing at the time. The trajectory was practically rectilinear and the movement very slow.

THE INERT CONSTITUENTS OF THE ATMOSPHERE.[1]

THE discovery of an element always awakens interest; for the total number of the known elements does not exceed seventy-five, and all the various forms of matter which exist on this globe are necessarily composed of these elements.

Elements must not be regarded as isolated entities, each self-dependent, having no relations with its compeers; on the contrary, all the elements exhibit certain connections with their neighbours; and there is to be traced an orderly progression from one class of elements, strongly electro-positive in character, metallic in appearance, very inflammable when heated in the air, and at once attacked by water, to another class, highly electro-negative, transparent, unattackable by oxygen, and without perceptible action on water, through a number of connecting links, each of which serves to soften the transition.

These elements have been arranged in series, and it is by considering the method of arrangement that our interest is awakened.

The revival of the hypothesis of the atomic constitution of matter by Dalton and of his attempt to determine the atomic weights of the elements was not long in provoking the guess that perhaps there could be found some connection between the numbers representing the relative atomic weights of kindred elements. But, as is well known, the state of knowledge in Dalton's day was not sufficiently advanced to enable him to attribute to elements their correct relative atomic weights; and it was not until the eminent professor of chemistry in Rome, Cannizzaro, whose jubilee has recently been celebrated, pointed out the bearing on Dalton's numbers of all the facts accumulated up to the year 1856 that the close relationship between the atomic weights and the properties of the elements was suggested by John Newlands. Some years later Lothar Meyer and Dmitri Mendeléef amplified and elaborated the ideas which had first been propounded by Newlands; and the periodicity of the atomic weights and the gradual variation of the properties of the elements and their compounds were established on a firm basis.

The division of the elements into metals and non-metals corresponds broadly with another well-marked division—that into basic and acidic. Generally speaking, it is the oxides of the metallic elements which react with water to form bases, and those of the non-metals which form acids with water. According to modern ideas, bases, by the mere act of solution in water, are supposed to be split up into portions, for which the term ion, invented by Faraday, has been retained; one ion is charged by the process of solution with a positive charge, and that portion is usually a metal; the other portion, which consists of one or more groups of hydrogen and oxygen in combination, termed "hydroxyl"—OH—has a negative charge. A base, indeed, is a compound which splits in this manner. On the other hand, an acid, when dissolved in water, undergoes an analogous split; but in this case the electro-positive ion is always hydrogen, while the electro-negative ion may either be an element such as chlorine, or a group of elements such as exist in nitric acid (NO_3).

The order of the various elements in the electric series has been determined; and not merely determined, but to each has been attached a numerical value. This value is identical with what is termed "chemical affinity"; and it represents the electric potential of the element with reference to an arbitrary starting-point, which does not differ much from that of nickel, an element closely related to iron. Only a few such values have as yet been determined numerically; instances may be chosen from the magnesium group, where the numbers run: Magnesium = + 1·2; Zinc = + 0·5; Cadmium = + 0·19; or from the fluorine column, where the numbers are: Fluorine = – 2·0; Chlorine = – 1·6; Iodine = – 0·4. In each case the potential, positive or negative, is the highest for the element with smallest atomic weight, and decreases with increase of atomic weight, for elements in the same column. The order of some of the elements is: Cs Rb K Na Li Ba Sr Ca Mg Al Mn Zn Cd Fe″ Co Ni Pb H Cu Ag Hg′Pt″″ Au′″; and for electro-negative ions, S″ O″ I Br Cl F; the first element, cæsium, being the most electro-positive, and the last, fluorine, the most electro-negative.

The order given above corresponds fairly well with the order in the periodic table, passing from left to right. But, as in the table, the atomic weights follow each other continuously round the cylinder or round the spiral, the abrupt change from elements of an extreme electro-negative character, like fluorine to sodium, an element of highly electro-positive character, or from chlorine to potassium, has always appeared remarkable. The old dictum, *Natura nihil fit per saltum*, if not always true (else we should have no elements at all, but a gradual and continuous transition from one kind of matter to another—a condition of affairs hardly possible to realise), has generally some spice of truth in it; and it might have been predicted (and the forecast seems to have been made obscurely by several speculators) that a series of elements should exist which should exhibit no electric polarity whatever. Such elements, too, should form no compounds, and, of course, should display no valency; they should be indifferent, inactive bodies, with no chemical properties.

The discovery of argon in 1894, followed by that of terrestrial helium in 1895, and of neon, krypton and xenon in 1898, has shown the justice of the foregoing remarks. Inasmuch as the methods employed for the isolation of these elements illustrate their properties and confirm the views as to their inertness and lack of electric polarity, I propose to sketch shortly the history of their discovery.

An accurate investigation of the density of atmospheric nitrogen and of nitrogen prepared from its compounds led Lord Rayleigh to inquire into the cause of the density of the nitrogen of the atmosphere exceeding that of "chemical nitrogen" by about one part in two hundred, whereas the accuracy of his experiments was such that it would have excluded an error of one part in five thousand. I need not here allude to the reasons which were at first put forward to account for this anomaly; suffice it to say that they offered no explanation; and that we ultimately traced the discrepancy to the presence in "atmospheric nitrogen" of a gas nearly half as dense again as nitrogen.

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[1] Abstract of an evening lecture delivered at the meeting of the British Association at Glasgow, September 13, by Prof. W. Ramsay, F.R.S.

A convenient form of apparatus for isolating this gas is shown in Fig. 1. The gas, air mixed with oxygen, is confined over mercury in an inverted test-tube, in contact with a few drops of a solution of caustic potash; and by connecting the rings with wires from the secondary coil of an induction apparatus, sparks pass between the platinum terminals in the interior of the test-tube. The volume of the gas rapidly diminishes; and in a few hours the gas is removed to a clean tube, and the excess of oxygen absorbed by burning phosphorus; the inert gases remain behind.

On a larger scale, the apparatus used by Lord Rayleigh, consisting of a balloon of six litres capacity, in the interior of which an electric flame is kept alight by means of a transformer, while a jet of caustic alkali forms a fountain in the interior, gives good results. By its help seven or eight litres of mixed gases can be made to combine per hour.

Such experiments show the inactive nature of the argon group of gases towards an electro-negative element, oxygen.

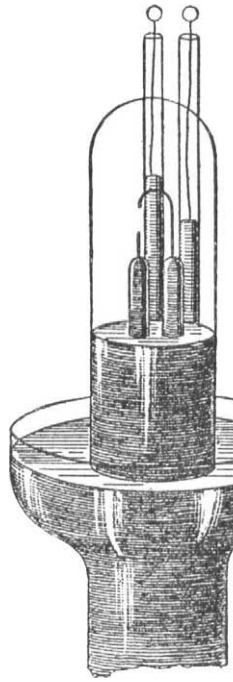

FIG. 1.

The gases are absolutely incombustible. No other elements can withstand such treatment, save platinum and its congeners and gold. But even these metals combine with fluorine or chlorine when heated in a current of one or other gas. Argon, however, is wholly unaffected when electric sparks are passed through its mixture with chlorine or fluorine, the two other most electro-negative elements. To them, too, it shows itself completely indifferent.

A more convenient method of separating the nitrogen from its admixture with argon in atmospheric air is by means of red-hot magnesium. The metal magnesium, which is now made on a considerable scale for photographic and signalling purposes, is a white, silvery metal, which can be planed or turned into shavings. In the early experiments a measured quantity of atmospheric nitrogen dried by passing over suitable drying agents was brought into contact with magnesium turnings, heated to redness in a tube of hard glass. It has been found, however, by M. Maquenne that the metal calcium, which, for this purpose is most easily produced by heating together a mixture of magnesium filings and pure dry lime, is a more efficient absorbing agent for nitrogen, for it does not require such a high temperature and can be effected without danger of melting the glass tube. Indeed, the operation is a very easy one and can be carried out with the very simple apparatus shown in Fig. 2. M. Guntz has also found that lithium, an element belonging to the same column in the periodic table as sodium and potassium, is an exceedingly good absorbent for nitrogen, for it tarnishes in nitrogen even at atmospheric temperature owing to the formation of a nitride.

On a large scale the magnesium turnings are contained in iron tubes and the gas-holders are made of copper or of galvanised iron. By this means fifteen litres of argon were separated from about two cubic yards of air.

The inactivity of argon in contact with such highly electro-positive elements as lithium, magnesium and calcium again demonstrates its want of electric polarity. No other elements would have resisted such treatment except those of the argon group. But these are not the only data from which such a conclusion can be drawn, for it was found that no action takes place between argon and hydrogen, phosphorus, sulphur, tellurium, caustic soda, potassium nitrate, sodium peroxide, sodium persulphide, nitro-hydrochloric acid, bromine-water and many other reagents which it would be tedious to mention, all of which are remarkable for their chemical activity. We may therefore take it that the name "argon," which means "inactive," has been happily chosen.

In attempting to form compounds of argon, however, another consideration was not lost sight of; if compounds of argon were capable of existence they ought to exist in nature, and, as in all probability they would be easily decomposed by heat, it ought to be possible to decompose them with evolution of argon, which could be collected and tested. Prof. Miers, in a letter which he wrote me the day after an account of the fruitless attempts to cause argon to combine had been given to the Royal Society, drew my attention to experiments by Dr. Hillebrand of the United States Geological Survey, in course of which he obtained a gas, which he believed to be nitrogen, by treating the rare mineral clevite, a substance found in felspathic rocks in the south of Norway, with sulphuric acid. The chief constituents of clevite are oxides of the rare elements uranium and thorium, and of lead. The gas obtained thus, after purification from nitrogen, was examined in a Plücker tube with the spectroscope and exhibited a number of brilliant lines, of which the most remarkable was one in the yellow part of the spectrum, similar in colour to the light given out by the glowing tube. The position of this line, and of others which accompany it, established the identity of this gas, not with argon, as was hoped, but with a supposed constituent of the sun's chromosphere, first observed by M. Janssen of Paris, during an eclipse which was visible in India in 1868. The late Sir Edward Frankland and Sir Norman Lockyer, who studied the spectrum of the chromosphere, gave to the supposititious element, which they regarded as the cause of these lines, the name "helium," a word derived from "ἥλιος," Greek for "the sun." Having been placed on the track, I examined, with the assistance of Dr. Collie and Dr. Travers, no fewer than 51 minerals, while Sir Norman Lockyer examined 46 additional ones, which we had not examined, and in 19 minerals, almost all of them containing uranium, helium was found. Only one gave an argon spectrum, namely malacone. We also sought for argon and helium in meteorites, which all give off gas on heating; but in only one specimen, a meteorite from Augusta County, Virginia, was helium found, in this case accompanied by argon. All natural waters contain argon, for that gas is somewhat soluble in water (4·1 volumes per 100 of water at 15° C.); but some also contain helium, as for instance

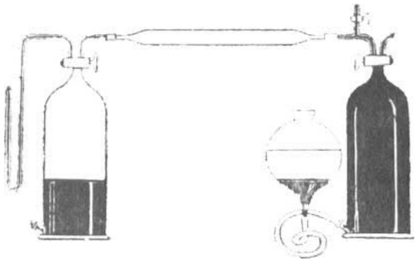

FIG. 2.

the gas from the Bath springs, which Lord Rayleigh found to contain argon mixed with about 8 per cent. of its volume of helium; and helium has also been found in mineral springs at Wildbad, and at Cauterets, in the Pyrenees. It would appear, then, that helium is not such a very rare constituent of our globe; and, indeed, it is probable that it is continually escaping from the earth in small quantities in certain regions.

In 1897, as president of the Chemical Section of the British Association, I chose the title "An Undiscovered Gas" for the address to the Section. The arguments in favour of the existence of such a gas were briefly these: The differences between the atomic weights of consecutive elements in the columns of the periodic table are approximately 16 to 20; thus 16·5 is the difference between the atomic weights of fluorine and chlorine; 16 between those of oxygen and sulphur, and so on. Again, stepping one pace down the scale, we have 19·5 as the difference between chlorine and manganese; 20·3 between sulphur and chromium; 19·8 between silicon and titanium, &c. The total difference between manganese and fluorine is 36; between chromium and oxygen, 36·3; between vanadium and nitrogen, 37·4; and between titanium and carbon, 36·1. This is approximately the difference between the atomic weights of helium and argon, 36. I quote now from that address: "There should, therefore, be an undiscovered element between helium and argon, with an atomic weight 16 units higher than that of helium, and 20 units lower than that of argon, namely 20. And if this unknown element, like helium and argon, should prove to consist of monatomic molecules, then its density should be half its atomic weight, 10. And pushing the analogy still further, it is to be expected that this element should be as indifferent to union with other elements as the two allied elements."

Those who care to read the story of the search for this undiscovered element may find it in the address. Minerals from all parts of the globe, mineral waters from Britain, France and Iceland, meteorites from interstellar space; all these were investigated without result. Helium from various minerals was separated by long and tedious processes of diffusion into a possibly lighter portion, diffusing more rapidly, and a possibly heavier portion diffusing more slowly, but with no positive result. The systematic diffusion of argon, however, gave a faint indication of where to seek for the missing element, for the density of the more rapidly diffusing portion was 19·93, while that of the portion which diffused more slowly was 20·01.

The invention by Dr. Hampson of an apparatus by means of which it is possible to obtain liquid air at small expense and with little trouble placed a new instrument in our hands; and Dr. Travers and I prepared 15 litres of argon from the atmosphere, with the purpose of distilling it fractionally, after liquefaction; for we knew, from the researches of Prof. Olszewski of Cracow, who has done so much to determine the properties of liquefied gases, that argon could be liquefied easily by compressing it into a vessel cooled by help of liquid air. And, moreover, we were in hope that by fractionating the air itself gases of even higher atomic weight than argon might possibly be obtained. Both expectations were realised; on distilling liquid argon the first portions of gas to boil off were found to be lighter than argon, and on allowing liquid air to boil slowly away heavier gases came off at the last. It was easy to recognise these gases by help of the spectroscope, for the light gas, to which we gave the name *neon*, or "the new one," when electrically excited emits a brilliant flame-coloured light; and one of the heavy gases, which we called *krypton*, or "the hidden one," is characterised by two brilliant lines, one in the yellow and one in the green part of the spectrum. The third gas, named *xenon*, or "the stranger," gives out a greenish-blue light and is remarkable for a very complex spectrum, in which blue lines are conspicuous.

Although neon was first obtained by the fractional distillation of argon, it was afterwards found convenient to prepare it direct from air. The torpedo-compressor, which is used for compressing the air before it enters Dr. Hampson's liquefier, was made to take in the air which had escaped liquefaction in the liquefier; the denser portions were thus liquefied, and the lighter portions were liquefied by compressing them into a vessel cooled by the denser fractions, boiling under reduced pressure, and consequently at a specially low temperature. This liquefied portion was again fractionated, and yielded neon; and it was not long before we discovered that helium was also present in the mixture. The presence of helium in atmospheric air had previously been noted by Prof. Kayser of Bonn, and by Prof. Friedländer of Berlin, on submitting the spectrum of argon to a searching examination.

The purification of this mixture of neon and helium from argon, although a lengthy process, was not attended by any special difficulty. It was accomplished by repeated distillation, the lighter portions being always collected separately from the heavier portions, and again distilled by themselves. But after this separation had been accomplished, we found that we were unable by means of liquid air to liquefy the mixture, or indeed any portion of it. We effected a partial separation by diffusion; but it is not possible to separate by this method two gases of which the quantity is limited. Another attempt was made by dissolving the gases in liquid oxygen, on the supposition that neon might prove more soluble than helium; but without satisfactory results. It was evident that a lower temperature than that possible by help of liquid air was necessary.

Prof. Dewar had by that time succeeded in producing liquid hydrogen in quantity, and had indicated the principle, which is identical with that of Dr. Hampson's air-liquefier, although he has not published any detailed account of his apparatus. Dr. Travers undertook to investigate the subject; and after four unsuccessful trials he made a liquefier, with the help of Mr. Holding, the laboratory mechanician, by means of which a hundred cubic centimetres of liquid hydrogen could be easily and cheaply produced. There was then no difficulty in effecting the separation of neon from helium; for, while neon is practically non-volatile, when cooled by liquid hydrogen, remaining in the state of solid or liquid, even that enormously low temperature is not sufficient to convert helium into a liquid. Hence the gaseous helium could be pumped away from the non-gaseous neon, and the latter was obtained in a pure state.

The residues obtained from the evaporation of about thirty litres of liquid air, after being freed from oxygen and nitrogen, were liquefied by help of liquid air, and fractionated from each other. The separation offered no special difficulty, but was long and tedious. It soon appeared that when most of the argon had been removed the residue solidified when cooled; but while it was possible to remove the krypton by pumping, for it goes into gas slowly even at the low temperature of liquid air, very little xenon accompanied it; for at that temperature xenon is hardly at all volatile.

Having finally separated the gases, their densities and other properties were carefully determined; and it was also proved that they are like argon and helium, inasmuch as their molecules consist of single atoms. Neon, as was expected, turned out to be the missing link between helium and argon; the atomic weight of krypton was found to be 81·6, and that of xenon 128. The volumes occupied by equal numbers of molecules of the liquefied gases were determined; and also the boiling-points and melting-points of argon, krypton and xenon. These figures are shown in the following table:—

	Helium.	Neon.	Argon.	Krypton.	Xenon.
Density of gas.........	1·98	9·96	19·96	40·78	64·0
Atomic weight.........	3·96	19·92	39·92	81·56	128·0
Density of liquid ...	0·3 (?)	1·0 (?)	1·212	2·155	3·52
Boiling-points	—	—	−186·1°C.	−151·7°C.	−109·1°C.
Melting-points	—	—	−187·9°C.	−169·°C.	−140·°C.
Critical temperatures	—	—	−117·4°C.	− 62·5°C.	+ 14·75°C.
Critical pressures ...	—	— (Metres.)	40·20	41·24	43·50
Refractivity of gas...	0·124	0·235	0·968	1·450	2·368

In every case there is seen what is termed periodicity; that is, a gradual alteration with rise of atomic weight, of the densities of the liquids, of the melting-points, of the boiling-points, and of the retardation of light when passed through the gas.

Let us consider, in conclusion, the position of these elements in the periodic table; and it will be sufficient to confine our attention to the groups of elements which form the neighbouring columns. The atomic weights are given in round numbers.

Hydrogen.	Helium.	Lithium.	Beryllium.
1	4	7	9
Fluorine.	Neon.	Sodium.	Magnesium.
19	20	23	24
Chlorine.	Argon.	Potassium.	Calcium.
35·5	40	39	40
Bromine.	Krypton.	Rubidium.	Strontium.
80	82	85	87
Iodine.	Xenon.	Cæsium.	Barium.
127	128	133	137

It is evident that these new elements fall into their natural places between the strongly electro-negative elements of the fluorine group, and the very electro-positive elements of the lithium group, and that, in consequence of their lack of electric polarity and their inactivity they form, in a certain sense, a connecting-link between the two. It is curious, too, to notice that iodine, xenon, cæsium and barium form the ends of their respective columns. It is, of course, not impossible that other elements may be discovered, possessing similar properties, and yet higher atomic weights than these; but as yet there is no clue to guide us where to search for them.

It is difficult, owing to the impossibility of effecting a complete separation of the inactive elements from each other, to do more than hazard a guess as to their relative amount in air. As they are easily separated from the other constituents of air, there is no doubt as to their total amount; air contains 0·937 parts of argon and its companions by volume in 100 parts. Perhaps the table below may be taken as affording some indication of their relative amounts. Air contains by volume:—

0·937 part of argon per hundred.
One or two parts of neon per hundred thousand.
One or two parts of helium per million.
About one part of krypton per million.
About one part of xenon per twenty million.

It is of course not impossible that xenon may contain an even smaller proportion of a still heavier gas; but it is unlikely. Sea-water sometimes contains a grain of gold per ton; that is one part in 15,180,000; a grain of xenon is contained in about four hundredweights of air.

The problems suggested by the periodic table are by no means solved by the discovery of these aërial gases; but something has been done to throw light upon one obscure corner of the field. The gap between the electro-positive and the electro-negative elements has been bridged.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PRESIDENT ROOSEVELT has definitely decided not to accept Mr. Carnegie's offer of ten million dollars in Steel Trust bonds for public educational purposes. The provision attached to the offer to the effect that the Government should hold the bonds for a term of years is regarded as being especially objectionable.

THE scheme for the establishment of a University of Liverpool is beginning to take definite shape. A report upon the subject, submitted to the Liverpool University Committee on Monday, stated that the capital invested in land, buildings, equipments and endowments at University College, Liverpool, is not much less than 500,000*l*. To realise the ideal of a modern University, efforts will be made to raise a further capital sum of 330,000*l*. and an additional annual income of 9000*l*. Of the capital sum, 130,000*l*. would be required for additional college land and buildings. The remaining 200,000*l*. would supply an endowment for the professorial chairs and lectureships most urgently needed, especially in modern languages, chemistry and applied science, including electrotechnics. The additional yearly income of 9000*l*. would be needed for maintenance of the various departments, scholarships, equipment of the library, &c. The committee hope that the 330,000*l*. will be provided by gifts of Liverpool citizens and others interested in the highest education; and the additional income will be provided by increased grants from the Treasury, an annual grant from the Liverpool City Council, which, as it helped to create the college, will, it is hoped, give its aid in the establishment and maintenance of a Liverpool University.

THE annual conferences of science teachers arranged by the London Technical Education Board will be held on Thursday, January 9, and Friday, January 10, 1902, at the South-Western Polytechnic, Manresa Road, Chelsea, S.W. There will be four meetings, successively presided over by Mr. T. A. Organ, Sir Henry Roscoe, F.R.S., Principal Rücker, F.R.S., and the Countess of Warwick. The addresses to be delivered are as follows:—"Teaching of Hygiene," Miss Alice Ravenhill; "Mental School Hygiene," Dr. Francis Warner; "Teaching of Natural History," Mr. Frank E. Beddard, F.R.S.; "Value of Natural History Collections for Teaching Purposes," Prof. W. R. Bottomley; "American Systems of Nature Study," Mr. R. Hedger-Wallace; "Nature Study in Schools," Mr. D. Houston; "Technical Education in Rural Secondary Schools," Mr. E. E. Hennesey; "Pioneer Work in Secondary and Technical Education in Rural Districts," Prof. R. Meldola, F.R.S. A collection of home-made apparatus for science teaching in schools will be on view during the days of the conference. Applications for tickets of admission should be made to Dr. Kimmins, Park Lodge, Harrow-on-the-Hill, or to Mr. C. A. Buckmaster, 16, Heathfield Road, Mill Hill Park, W.

THE following resolutions passed by the committee of the Agricultural Education Association were confirmed at a general meeting of members held on Thursday last:—(1) That, if the Board of Agriculture retain their present educational work, it is essential that there shall be complete cooperation between that Board and the Board of Education on all educational matters specially affecting the agricultural classes. (2) That for purposes of agricultural education the country should be divided into districts, and such inspectors appointed as may be necessary. (3) That groups of counties, not yet affiliated to any collegiate centre, should be formed, each group being affiliated to some centre. (4) That, after due inquiry, reports should be issued dealing with the most appropriate forms of agricultural education for each county. (5) That permanent demonstration stations should be organised in each county or group of counties. (6) That official information bearing upon all matters of agricultural interest, whether educational or otherwise, should be distributed to the public free of cost. (7) That to carry out the above objects it is essential that larger funds be placed at the disposal of the Board of Agriculture for educational purposes. (8) That the work of the Board of Agriculture might be facilitated by the appointment of a consultative committee on the analogy of those of the Board of Education and of the Department of Agriculture in Ireland. (9) That copies of the above resolutions be sent to the Presidents of the Boards of Education and of Agriculture.

SIR WILLIAM ABNEY, K.C.B., opened the new science buildings in connection with Watford endowed schools on Thursday last. The new rooms comprise a lecture room, a physics laboratory, museum and balance room, a preparation room and a dark room, which, with the chemical laboratory (28 ft. by 24 ft.), erected in 1892, form a serviceable set of rooms, specially designed for science teaching. The cost of the additions has been about 2000*l*., and the sum previously expended on science buildings about 1000*l*. In the course of his remarks at the opening ceremony, Sir William Abney said he did not wish any of them to think that whilst they in the secondary branch of the Board of Education encouraged science in every possible way they discouraged the other branches of education which were given at the same time. One of the reasons for starting the schools of science on their present basis was to insure that any boy or girl going through a course of science should at the same time be educated in literary work, which was so necessary in education. Of course there was a great deal of difference between mere instruction and education. The utilitarianism of education was of minor importance; the great thing was education itself. If they could make the instruction that was given useful so much the better. In the old days the only possible means of education was by literary work, classics and so on. There was no science, and therefore they could not say that a boy or girl was to be educated in scientific methods; but he was certain those who founded schools like those at Watford were so alive to the necessity of education that they would be equally alive to the necessity of education in modern methods.

WE are glad to see that the subject of the coordination of the work of the Polytechnic Institutions of London with that of the Colleges was touched upon by Principal Rücker in the course of an address delivered at the South-Western Polytechnic, Chelsea, on Friday last. A place has been found for the Polytechnics in the reconstituted University of London, but their position is not clearly understood, and the direction in which their work may be usefully developed has not been sufficiently described. The Institutions provide opportunities for study and research, and the buildings, with those of other Colleges, help to make the University of London something more than a name. The standard of Polytechnic instruction is perhaps not so high in some cases as might be desired, but it can be raised in the course of time, and the efforts of friends of the University should be directed to this end. It is far better to make the best use of existing educational material than to neglect it. As Principal Rücker remarked, the endeavours that are being made are scattered, and the object of the University is to focus them into one strong effort in order that they may advance as a well-ordered army towards one common end. If that can be